

# **MARKSCHEME**

**MAY 2006**

**BIOLOGY**

**Higher Level**

**Paper 2**

*This markscheme is confidential and for the exclusive use of examiners in this examination session.*

*It is the property of the International Baccalaureate and must not be reproduced or distributed to any other person without the authorization of IBCA.*

## SECTION A

1. (a) old [1]
- (b) (i) old dive longer (than the young males);  
young swim faster (than the old males); [2 max]  
*Reject answers giving quoted figures without comparison*
- (ii)  $1.5 (\pm 0.2) \text{ km h}^{-1}$  (units required) [1]
- (c) no ventilation/breathing/air available;  
anaerobic respiration takes place;  
oxygen not used / used up / not replaced / no oxygen / low levels of oxygen;  
glucose / pyruvate is broken down to lactate;  
(some) energy/ATP is produced / needed;  
muscles contracting/working (during dive); [3 max]
- (d) *Award 1 mark for two or three of the following and 2 marks for all four.*  
dive time shorter in September (than August) / little difference;  
speed faster in September (than August) / little difference;  
dive time shorter later in the day / little difference;  
speed slower later in the day; [2]
- (e) both charts show (mean) dive time is longer in older whales;  
little difference in either chart in speed / no trend in Fig 1 but Fig 2 shows young whales swim faster; [2]
- (f) data shows little difference due to number / distance of boats;  
no (evidence of) harmful consequences from whale-watching / ecotourism;  
not enough data (to be sure of effects);  
other behaviours not studied / only two behaviour patterns studied; [3 max]
- (g) male behaviour;  
effects of boat noise / movement / divers in the water;  
effects of boat size;  
effect of duration of boat visit;  
aggression;  
schooling / forming groups / play;  
reproduction / courtship;  
feeding behaviour;  
communication;  
direction of swimming/migration;  
long-term behaviour / observations on long-term effects;  
compare behaviour in areas with ecotourism with areas with none;  
compare behaviour after ecotourism started with behaviour before; [2 max]  
*Reject answers not referring to behaviour patterns or factors affecting behaviour*

2. (a) (i) autosomal;  
linked genes/linkage;  
together on same chromosome;  
as they did not separate / segregate; [2]
- (ii) *Accept any letters for the alleles of the two genes.*  
male genotype is  $BbTt/\frac{BT}{bt}$  and female genotype is  $bbtt/\frac{bt}{bt}$ ;  
*Reject Bb, Tt and bb, tt.*  
male gametes: BT and  $bt/\frac{BT}{bt}$  and  $bt$  female gametes: (all)  $bt/\frac{bt}{bt}$ ; [2 max]
- (iii)  $BbTt/\frac{BT}{bt}$  and  $bbtt/\frac{bt}{bt}$ ;  
  
1 / ½ / 50% brown tailed : 1 / ½ / 50% white tail-less; [2]
- (b) desired/specific gene obtained/selected;  
mRNA copied with reverse transcriptase;  
vector used / needed to get gene into host;  
restriction enzymes used to cut DNA / to open plasmid;  
sticky ends added / present;  
DNA / gene inserted into plasmid;  
DNA / gene spliced with DNA ligase;  
recombinant plasmid / recombinant DNA mixed with host cells;  
use of viral vectors / *Agrobacterium* used as a vector;  
shot gunning / gold / tungsten particles coated in genes and shot into host cell; [3 max]

3. (a) nanophytoplankton, bacteria, phytoplankton [1]  
*All three needed to receive [1].*
- (b) (i) 1°/primary or 2°/secondary consumer (*depending on chain marked*) [1]  
 (ii) 2°/secondary, 3°/tertiary or 4°/quaternary consumer (*depending on chain marked*) [1]  
*Marks may not be given if the arrows are not marked on the diagram.*
- (c) 1 / 2 % [1]
- (d) more macrozooplankton / phytoplankton eaten/numbers fall;  
 natural selection for small/camouflaged/fast growing/fast swimming plankton;  
competition between small fish is more intense;  
 natural selection among small fish for faster swimming/more skill in feeding;  
 more food for predators of small fish/named predator of small fish;  
 natural selection among predators for feeding on small fish/not on other prey;  
 changes in the gene pool/allele frequencies; [3 max]

## SECTION B

4. (a)

	Prokaryotic	Eukaryotic
DNA	naked / loop of DNA	associated with protein/histones / nucleosomes / DNA in chromosomes
location DNA	in cytoplasm / nucleoid / no nucleus	within a nucleus/nuclear membrane
membrane bound organelles	none	yes
ribosomes	70 S	80 S
plasma membrane	same structure in both groups	
cell wall	peptidoglycan / not cellulose / not chitin	cellulose / chitin / not peptidoglycan
respiratory structures	mesosomes / no mitochondria	mitochondria

*Award [1] for every line in the table.*

**[5 max]**

- (b) named prokaryotic pathogen *e.g. Borrelia burgdorfen/burgdorferi*;  
 name of the disease caused by prokaryote *e.g. lyme disease*;  
 main mode of transmission *e.g. tick bite*;  
 second mode of transmission;  
 one effect of disease *e.g. red circular, smooth rash*;  
 second effect *e.g. flu-like symptoms*;  
*If pathogen is not prokaryotic, then award [2 max] for this question.*

**[5 max]**

- (c) antigen/pathogen engulfed by macrophage (by endocytosis);  
 presentation of antigen by macrophage on membrane/MHC protein;  
 helper T-cell binds to macrophage;  
 helper T-cell activated;  
 activated helper T-cell binds to (inactive) B-cell;  
 B-cell is activated by helper T-cell;  
 B-cells start to divide/clone;  
 plasma cells formed / grow;  
 plasma cell increases numbers of rough ER / Golgi apparatus;  
 B cells / clones / plasma cells begin to produce antibodies to the specific antigen;  
 antibodies secreted / pass out through membrane (by exocytosis);  
 memory cells give long-term immunity / allow rapid antibody production;

**[8 max]**

*(Plus up to [2] for quality)*

5. (a) double helix;  
two chains of nucleotides / composed of nucleotides;  
nucleotides consist of base, deoxyribose (sugar) and phosphate;  
bases are adenine, cytosine, guanine and thymine;  
anti-parallel / strands;  
3'-5' links between nucleotides;  
hydrogen bonds between base pairs / purine and pyrimidine on opposite chains;  
only A-T and G-C / complementary base pairs are A-T and G-C ;  
two bonds between A-T and 3 between G-C; **[5 max]**  
*Credit can be given for any of these points shown on a correctly drawn and labelled diagram.*
- (b) more than one gene controls/affects one characteristic;  
*Reject more than 2 alleles*  
can cause continuous variation / many different possible phenotypes;  
*e.g. skin colour / other valid example;*  
allele of each gene promotes melanin production or not / other valid example;  
*e.g. grain colour in wheat / other valid example;*  
allele of each gene promotes pigment production or not / other valid example; **[5 max]**  
*If first or second example is incorrect do not accept third or subsequent examples.*
- (c) RNA polymerase controls transcription / is the enzyme used in transcription;  
DNA is unwound by RNA polymerase;  
DNA is split into two strands;  
mRNA is made by transcription;  
promoter region (by start of gene) causes RNA polymerase to bind;  
anti-sense/template strand of DNA is transcribed;  
direction of transcription is 5'-3' ;  
free nucleotide triphosphates used;  
complementary base pairing between template strand and RNA nucleotides/bases;  
*Accept this marking point if illustrated using a diagram*  
RNA contains uracil instead of thymine;  
terminator (sequence) stops RNA polymerase / transcription;  
mRNA is released / RNA polymerase released; **[8 max]**

*(Plus up to [2] for quality)*

6. (a) *light-dependent reaction: [3 max]*  
 chlorophyll absorbs light (energy)/ photons;  
 electron activated/excited;  
 electron passed down electron carriers;  
 ATP produced;  
 NADP<sup>+</sup> reduced / reduced NADP produced / NADPH produced;
- light independent reaction: [3 max]*  
 CO<sub>2</sub> fixed by/reacts with 5C molecule (RuBP);  
 rubisco/ribulose biphosphate carboxylase/RuBP carboxylase catalyses reaction;  
 (two) 3C molecules / glycerate 3-phosphate/GP produced;  
 reduced NADP and ATP used to reduce glycerate 3-phosphate/GP;  
 triose phosphate/TP produced; [6 max]
- (b) water is absorbed;  
 formation of gibberellin;  
 production of amylase;  
 amylase catalyzes digestion of starch to maltose / starch hydrolyzed to maltose;  
 maltose converted to glucose;  
 cell respiration; [4 max]
- (c) occurs in mitochondria;  
 oxidative phosphorylation;  
 electrons passed along carriers/electron transport chain;  
 carriers in inner mitochondrial membrane / cristae;  
 energy from electrons used to pump H<sup>+</sup>/protons into intermembrane space;  
 H<sup>+</sup>/proton (concentration) gradient formed;  
 ATPase/synthase in inner membrane;  
 movement of H<sup>+</sup>/protons down concentration gradient through ATPase/synthase;  
 rotation of (head of) ATPase/synthase;  
 energy released produces ATP;  
 by phosphorylating ADP /  $\text{ADP} + \text{P}_i \rightarrow \text{ATP}$  ;  
 oxygen is terminal (electron) acceptor (plus H<sup>+</sup> to make water); [8 max]
- Credit can be given for any of these points shown on a correctly drawn and labelled diagram.*

(Plus up to [2] for quality)



7. (a) *Award [1] for each named hormone and [1] for its correct function, up to [4 max]. Do not award marks for function only.*

estrogen;

builds up uterine lining / endometrium / prevents ovulation;

progesterone;

maintains uterine lining / endometrium / pregnancy ends when progesterone level drops / inhibits contraction of uterus / prevents ovulation;

HCG;

maintains / stimulates growth of corpus luteum;

oxytocin;

stimulates contraction of uterine muscle wall;

**[4 max]**

*Accept only the first two hormones named and their functions.*

- (b) nerve impulse reaches pre-synaptic knob / membrane;  
calcium ions/ $\text{Ca}^{2+}$  enter pre-synaptic neurone / knob;  
vesicles with neurotransmitter / acetylcholine release contents;  
neurotransmitter diffuses across synapse/synaptic cleft;  
binds to receptors on post-synaptic neurone/membrane;  
sodium ions/ $\text{Na}^+$  enter post-synaptic neurone / sodium channels open;  
depolarization / action potential / nerve impulse (in post synaptic neurone);  
calcium ions/ $\text{Ca}^{2+}$  pumped back into synaptic cleft/synapse;  
neurotransmitter broken down;

**[6 max]**

- (c) homeostasis is the maintenance of a constant level of the internal environment ;  
within narrow limits;  
involves negative feedback;

name of variable controlled;;

method of detection / monitoring;;

response to high / low levels of variable;;

how variable is brought back to set point;;

*Example 1 [3 max]:*

blood glucose level;

pancreas cells / islets/beta and alpha cells to monitor level;

insulin secreted with high blood glucose / glucagon with low blood glucose levels;

named method of raising / lowering level of blood glucose;

*Example 2 [3 max]:*

body temperature;

hypothalamus monitors temperature;

nerve impulses to skin / muscle / liver;

named method of raising / lowering level of body temperature;

**[8 max]**

*(Plus up to [2] for quality)*